

An Overview of EMAX: The Northeast U.S. Continental Shelf Ecological Network

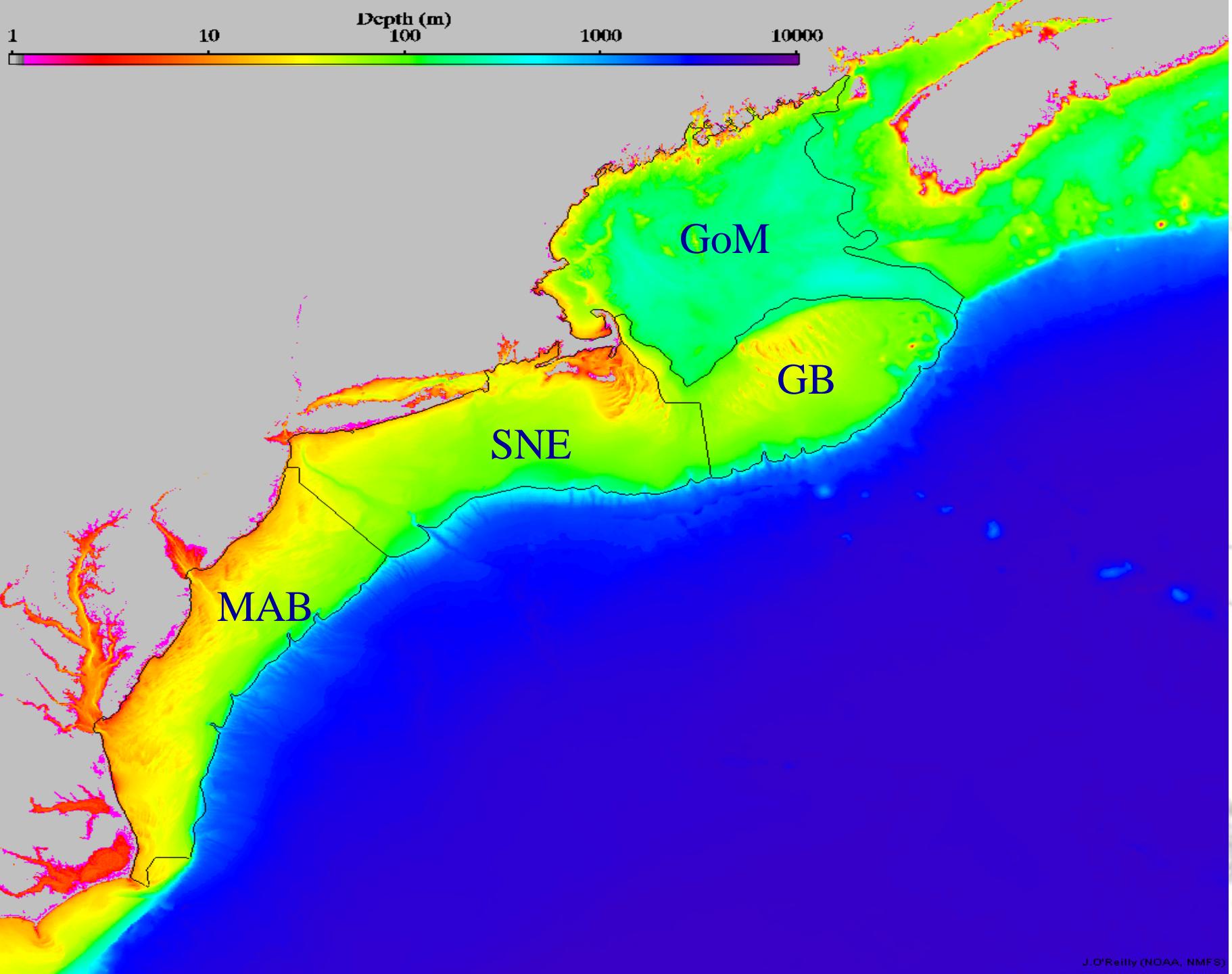
Jason Link*, William Overholtz, Jay O'Reilly, Jack Green,
Elizabeth Methratta, David Dow, Debra Palka, Chris Legault,
Steve Edwards, Gordon Waring, William Stockhausen, David
Mountain, Joseph Vitaliano, Vincent Guida, Joe Kane, Jack
Jossi, Michael Fogarty, Jon Brodziak, Carolyn Griswold,
Cami McCandless, Nancy Kohler, Steve Fromm, Laurel Col,
Tim Smith, Clyde MacKenzie, and Ron Goldberg

The Broader Context of EAF and NMFS NEFSC

- Multiple Initiatives, Reports, Commissions, Workshops, Conferences, Pending Legislation, etc.
- Continual issue of tradeoffs within and across ocean use sectors
- Ergo, we wanted to look at the key system components holistically and simultaneously

Considerations for EMAX

- Network Analysis
 - Spatial extent/resolution: entire NE Shelf, 4 sub-regions
 - 1996-2000
 - Allowed us to evaluate holistic, interdisciplinary, systemic tradeoffs
- Small pelagic emphasis
- In many respects, we were doing this already in pieces, but needed to organize, integrate, & synthesize this information



Why Emphasize Small Pelagics in a Network Analysis?

- Keystone species
- Mid trophic levels
- High number of interspecific interactions
- Highly Abundant currently
- Minimal Fisheries

What is Network Analysis?

Main focus of network analysis:

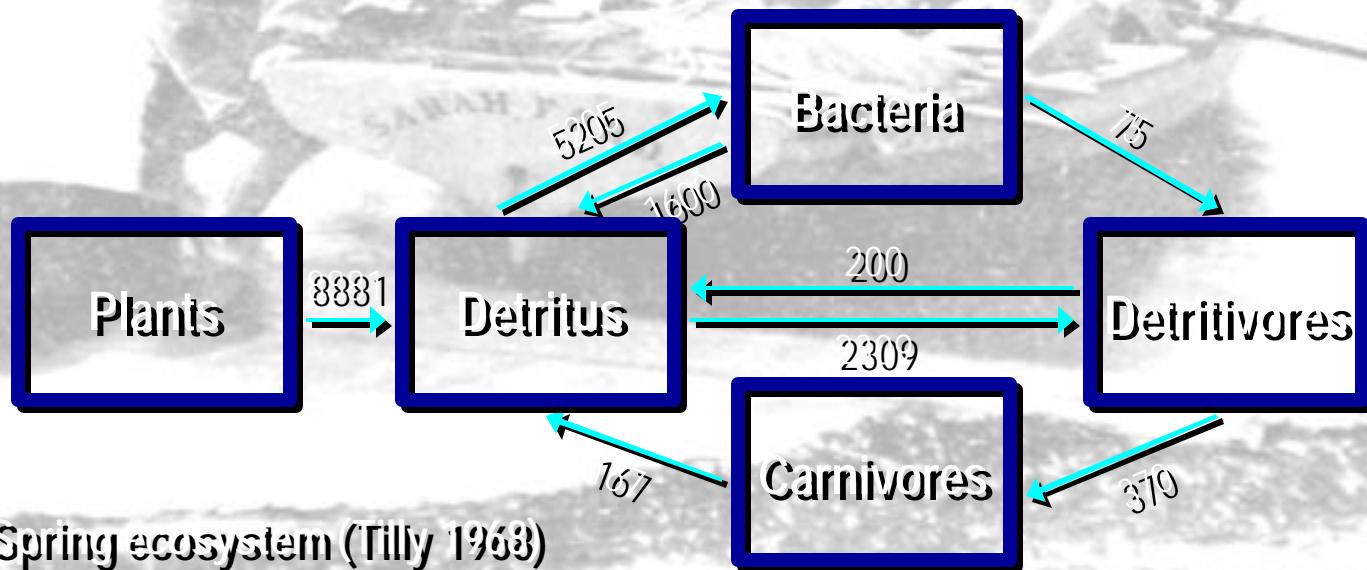
- Efficiency of flows
- Energy and material transfer, assimilation, and dissipation

(2nd Law of Thermodynamics – Entropy)

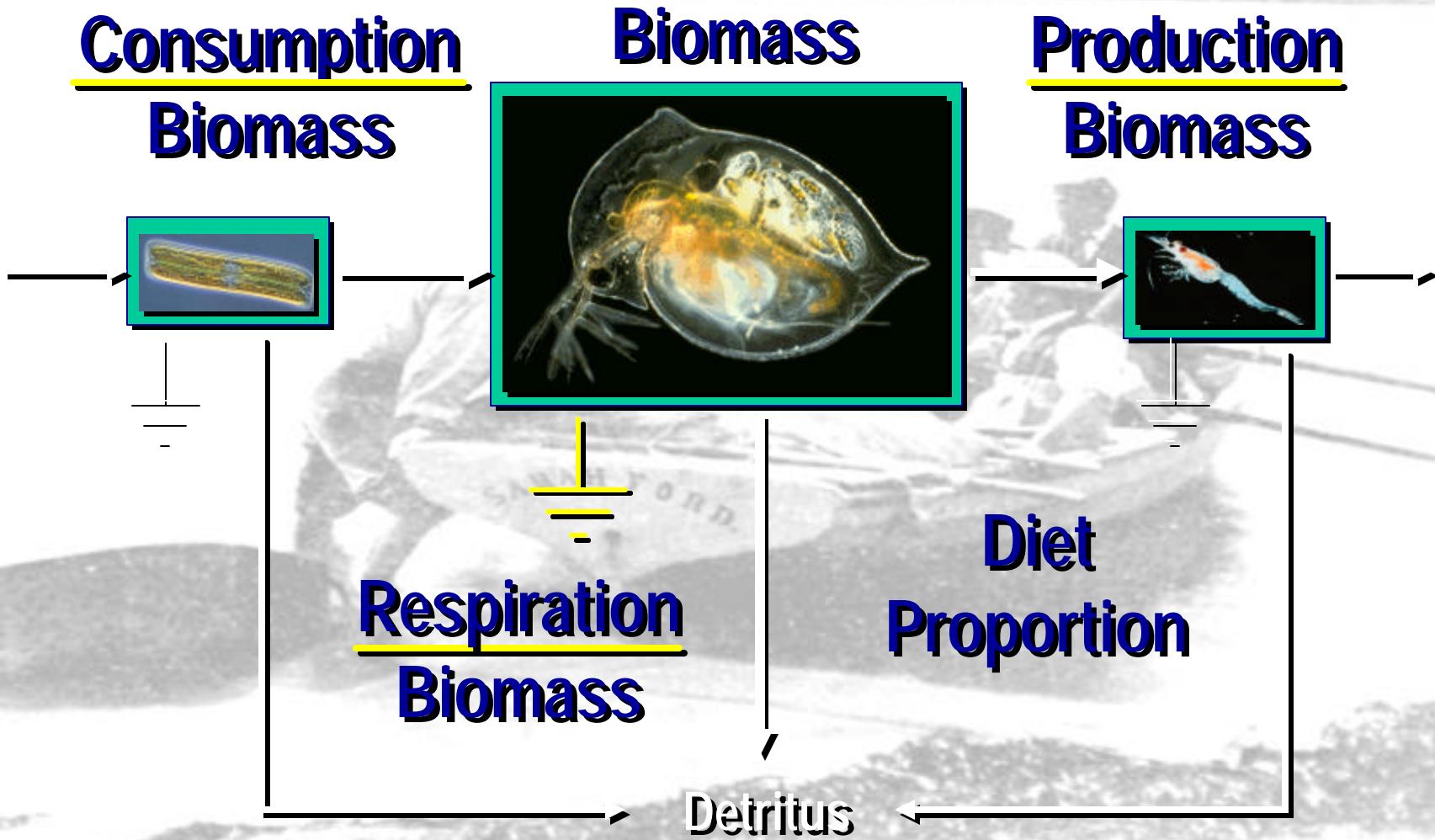
What is Network Analysis?

Networking terminology

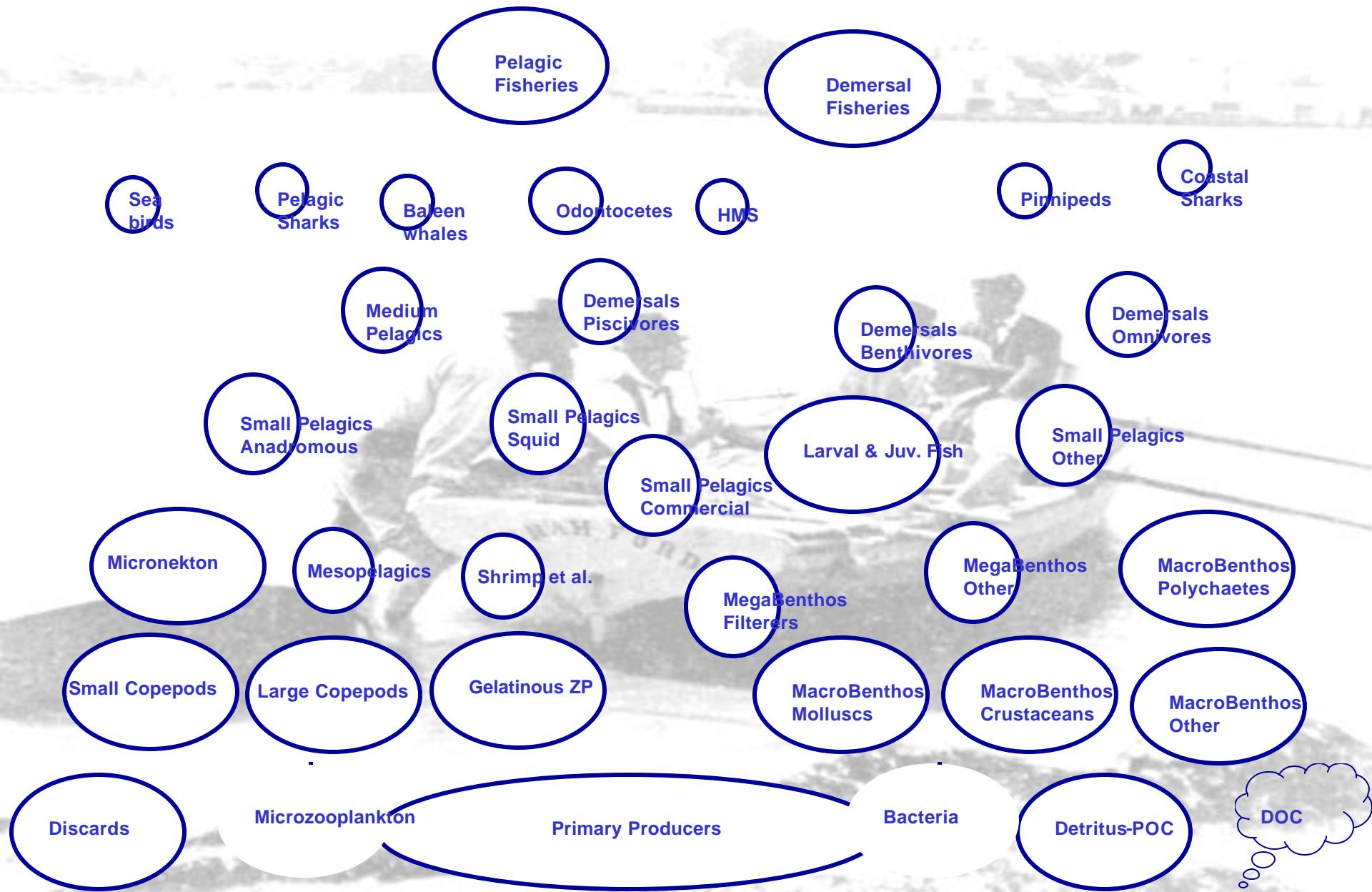
- Network - a collection of nodes joined together by flows
- Weighted flows - values assigned to the transfers between nodes



Required Data

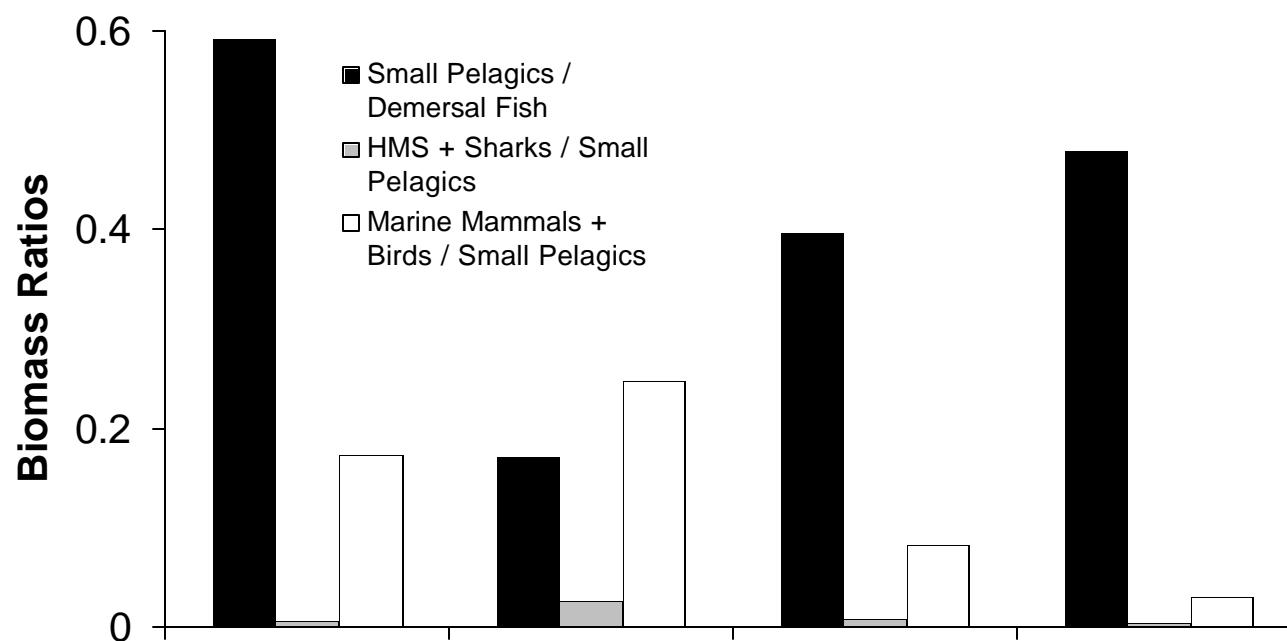
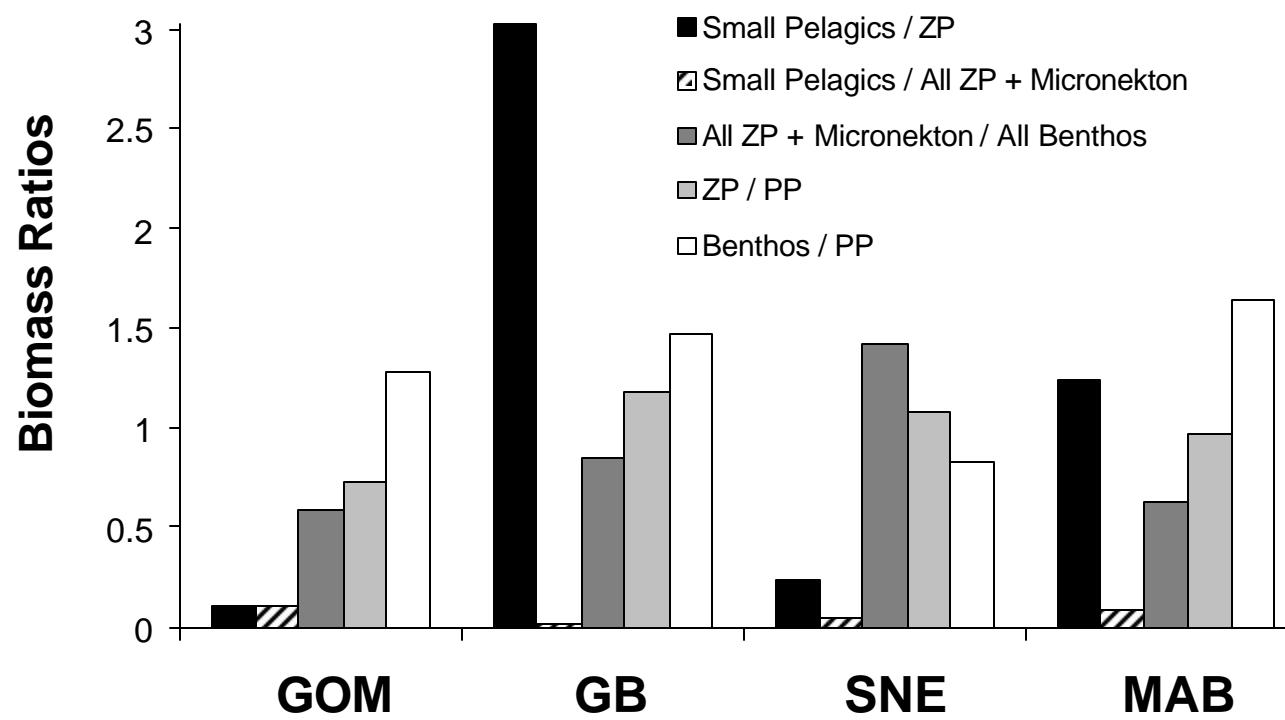


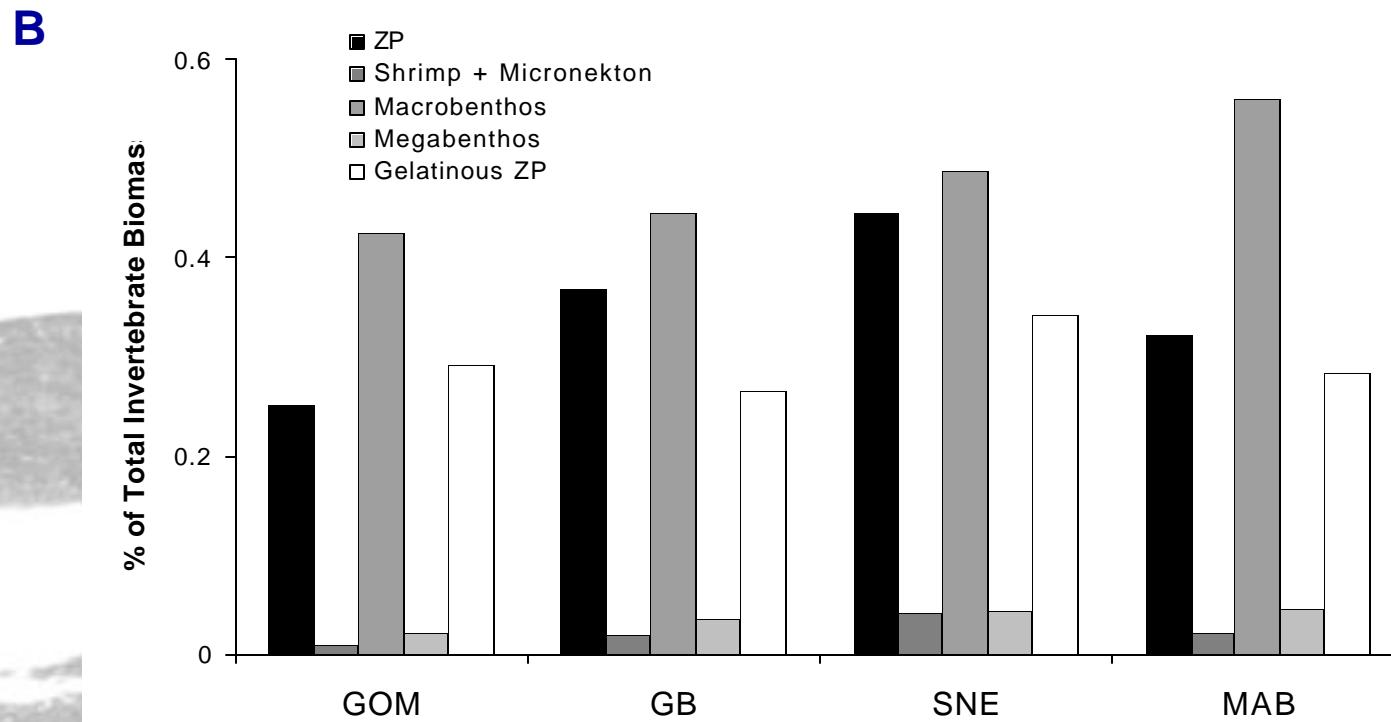
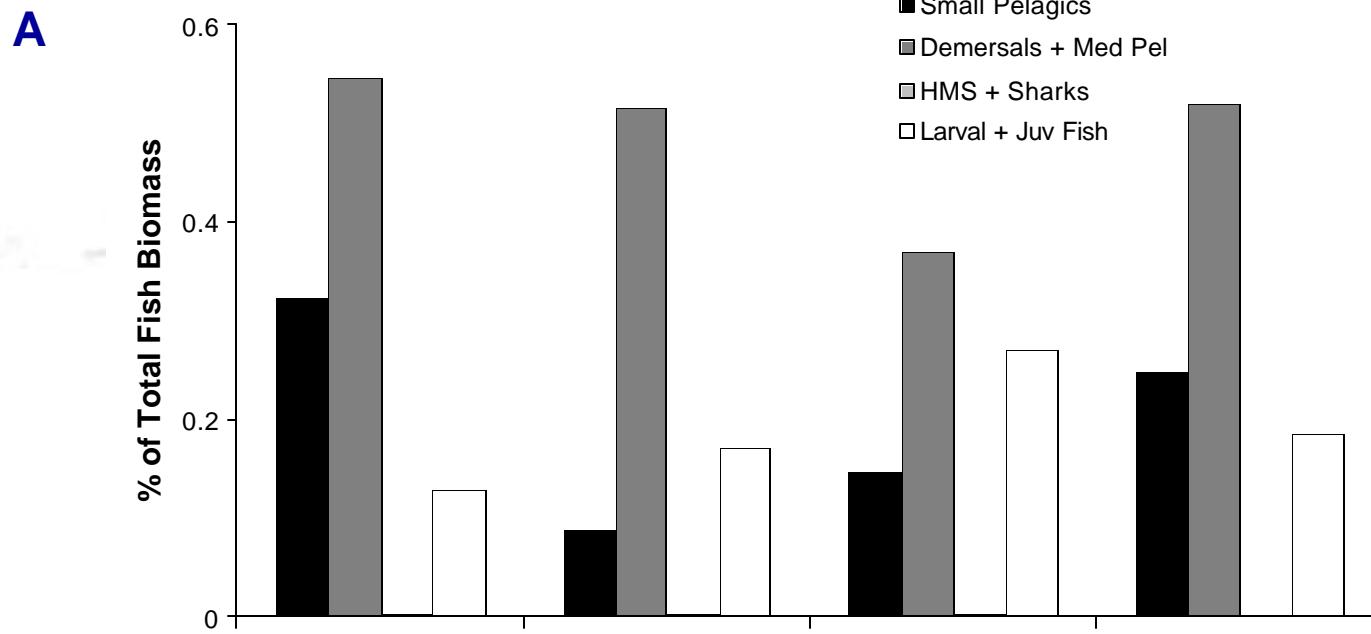
EMAX

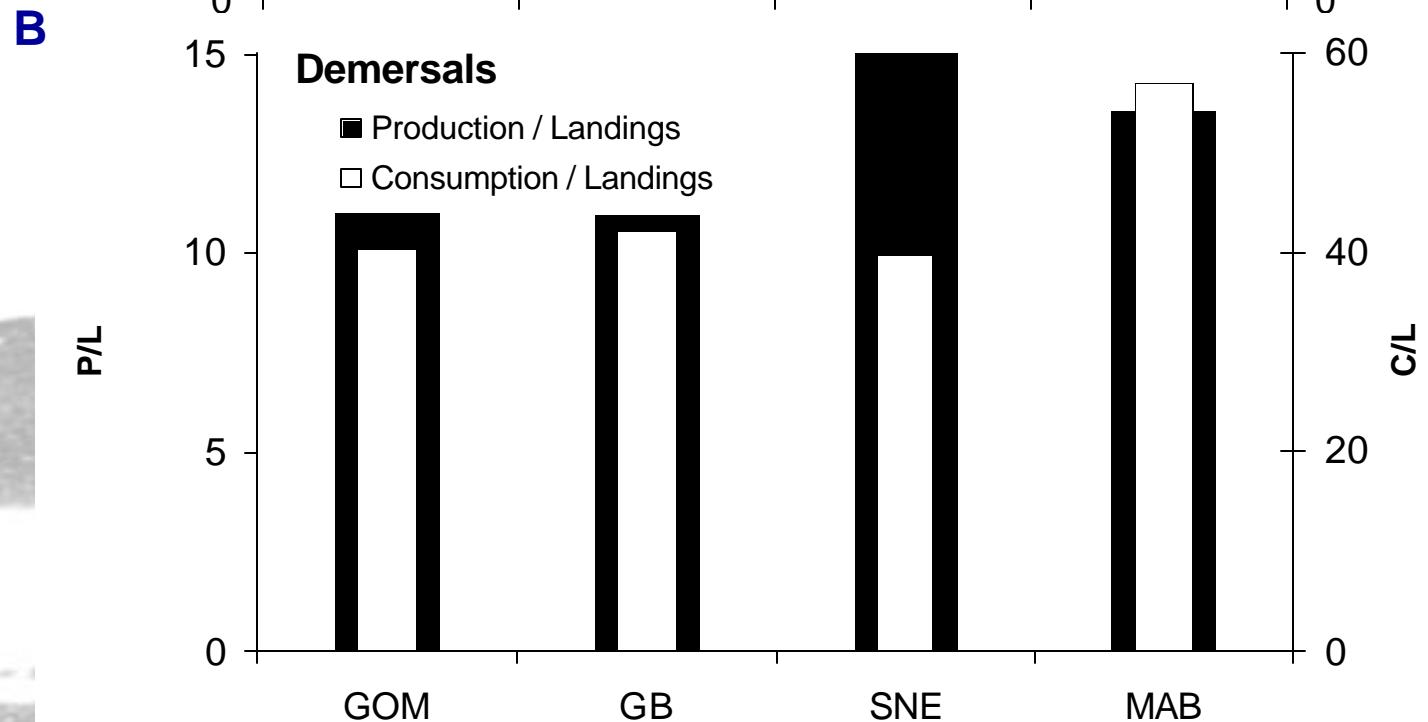
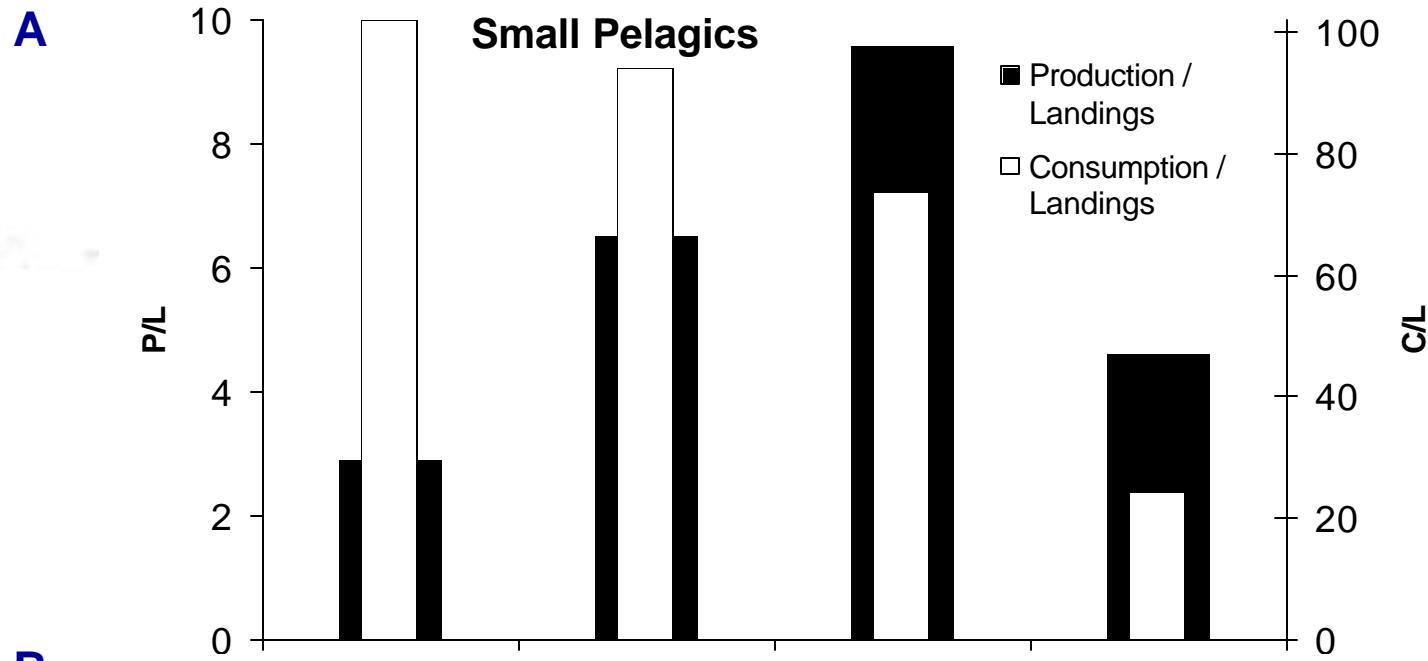


EMAX Model Comparisons

- Evaluated 7 model software packages
 - Different underlying philosophies, assumptions and equations
 - Selected 2 major software packages
- Overall, minimal difference between Ecopath & EcoNetwrk
 - Balancing was keyed off different diagnostics
 - Balancing changed different network elements

A**B**





EMAX Spatial Comparisons

- Minimal Differences Between 4 main regions
- Marine mammals less prominent in S
- Small pelagics major in GoM
- More small pelagics to ZP on GB
- Benthos more prominent in S

EMAX Scenarios

- 1/100, 1/10, ½, 2, 10, 100 x

All small pelagics

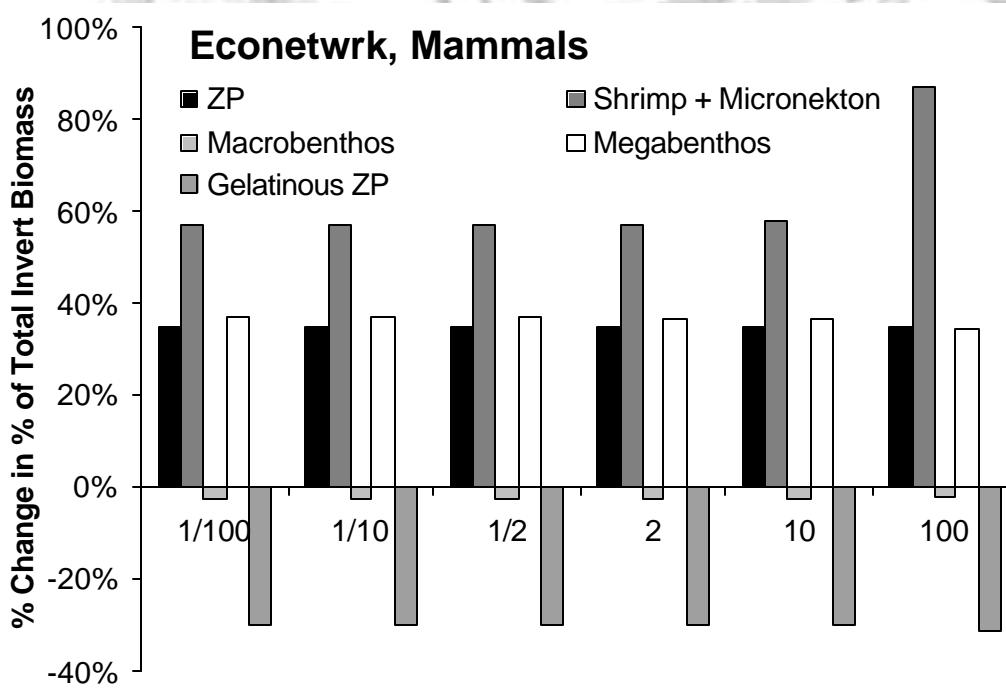
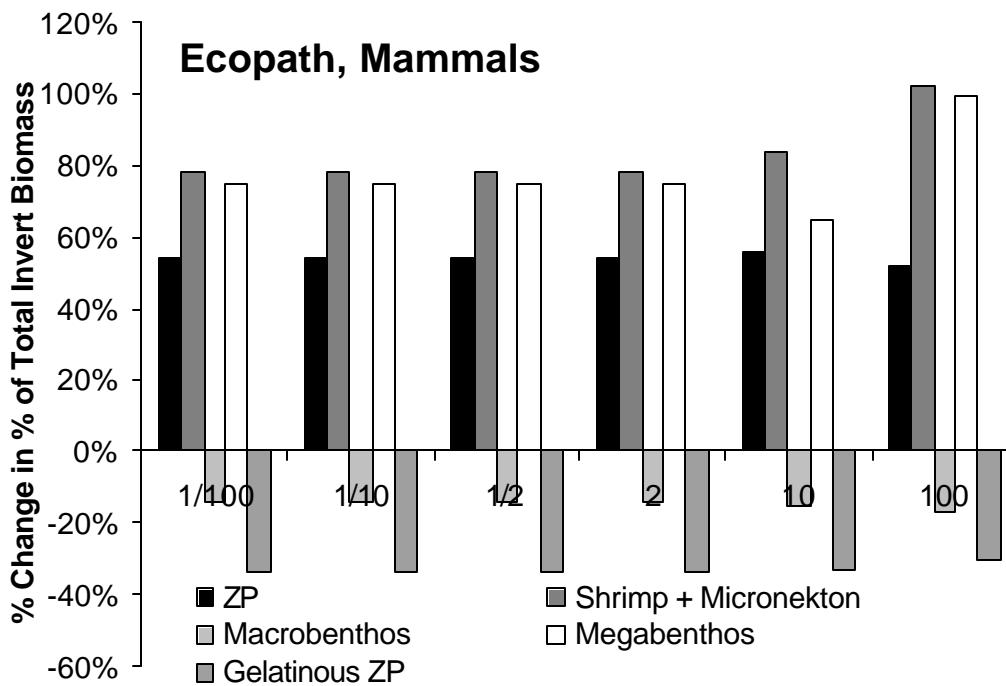
All demersals

All HMS & Sharks

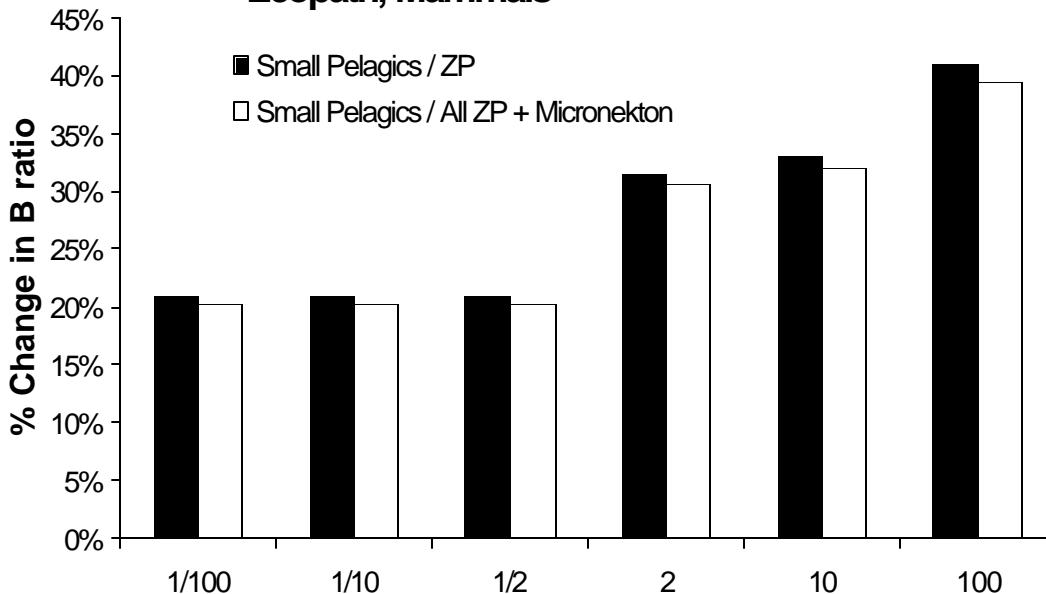
All Marine Mammals

EMAX Scenarios

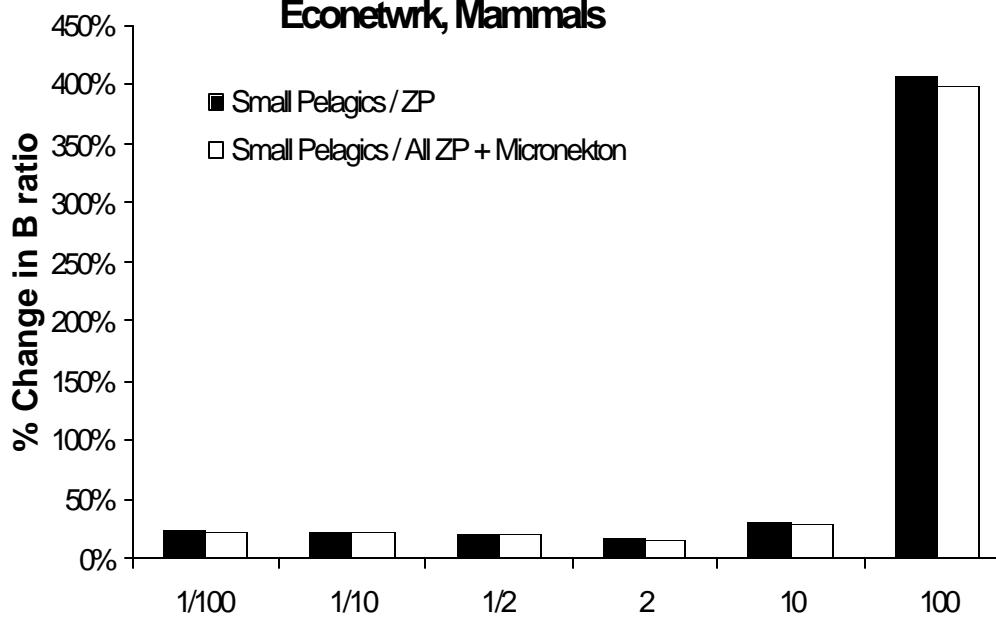
- Effects of Changes to Mammals on rest of system

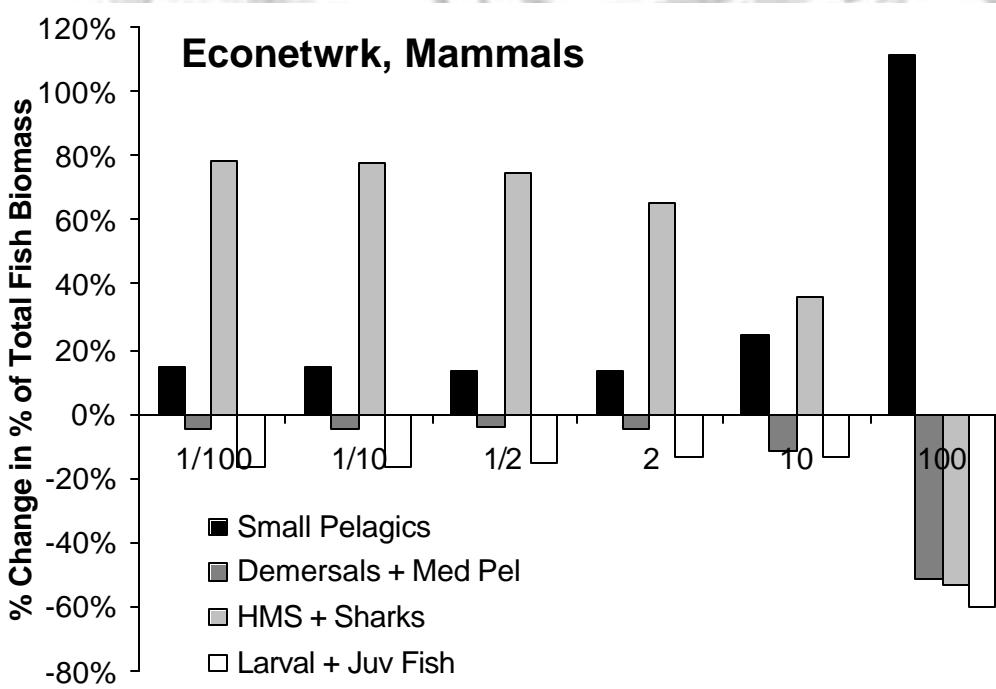
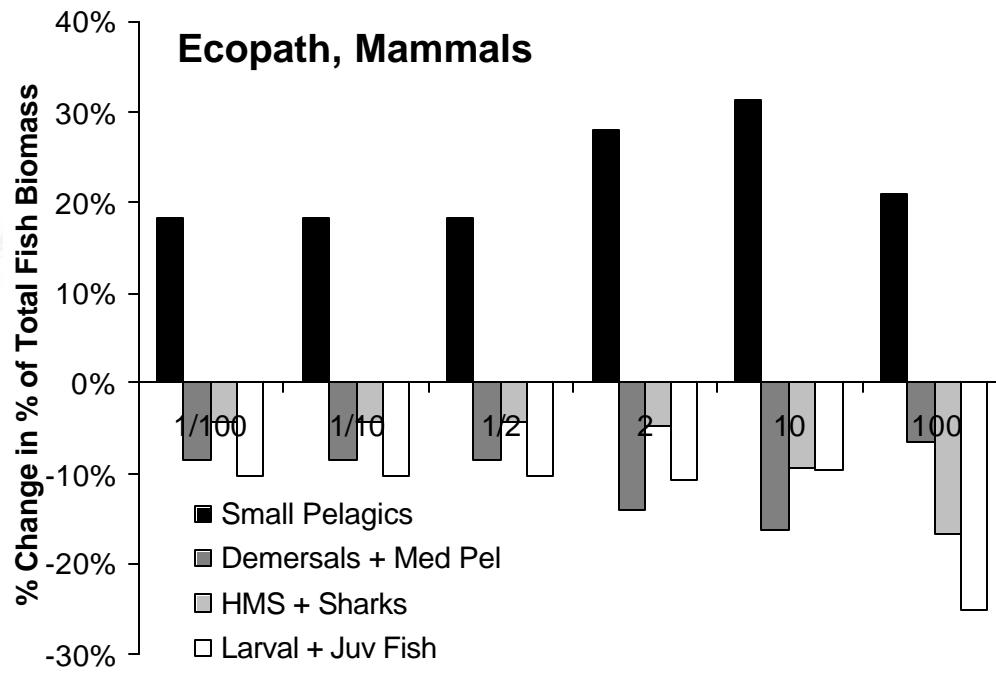


Ecopath, Mammals



Econetwork, Mammals

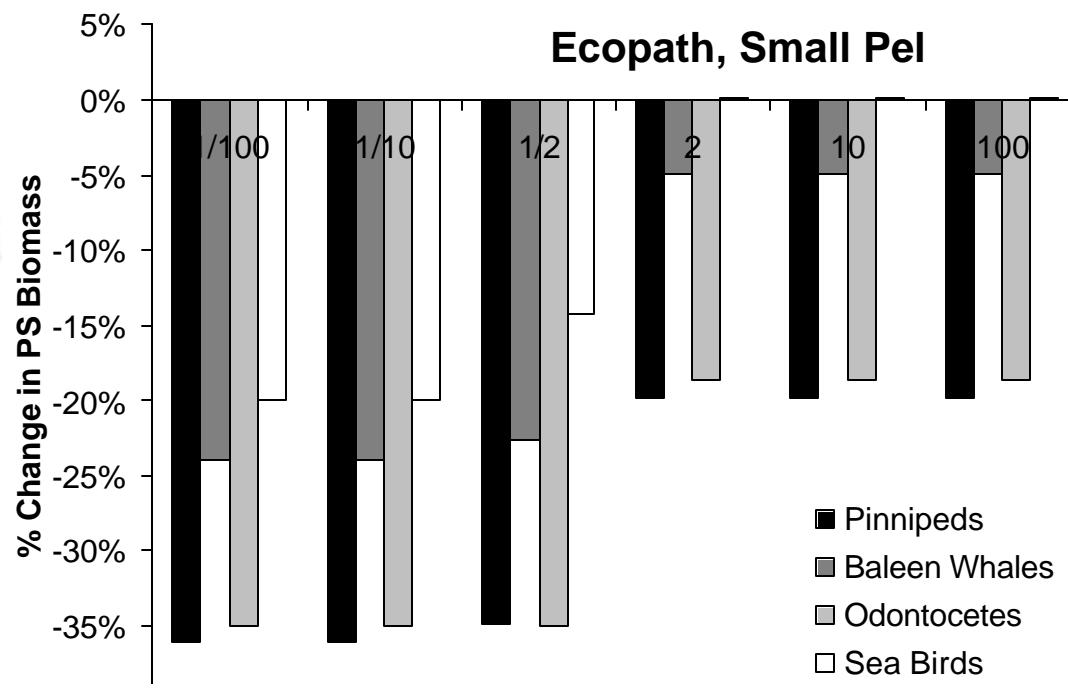




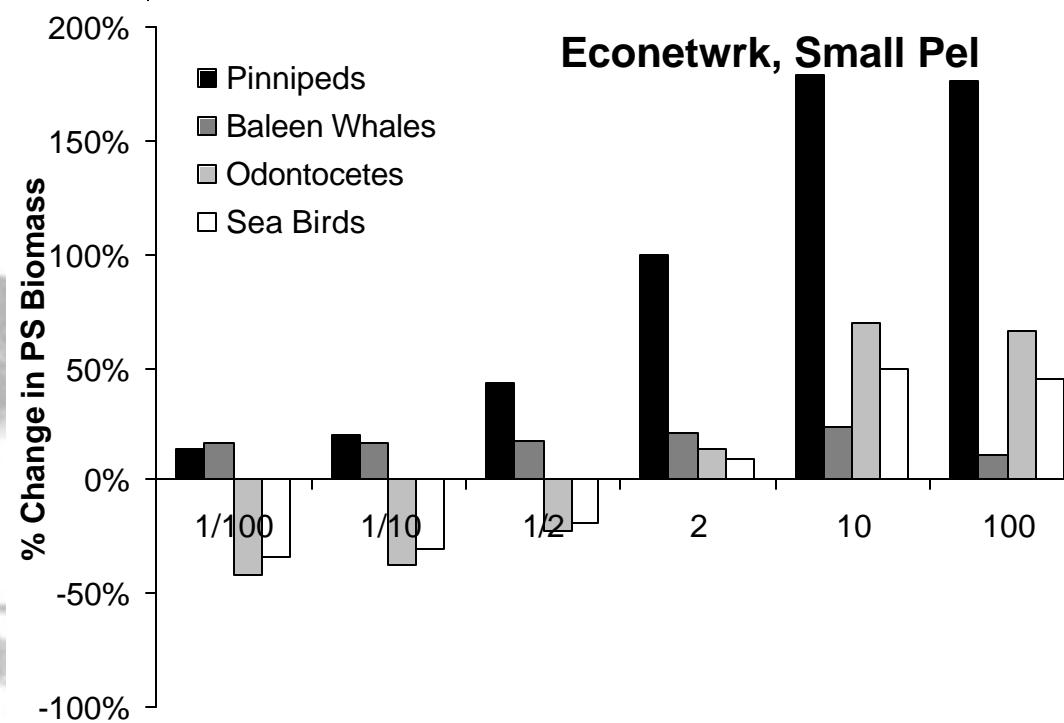
EMAX Scenarios

- Effects of Changes to rest of system on Marine Mammals and Seabirds

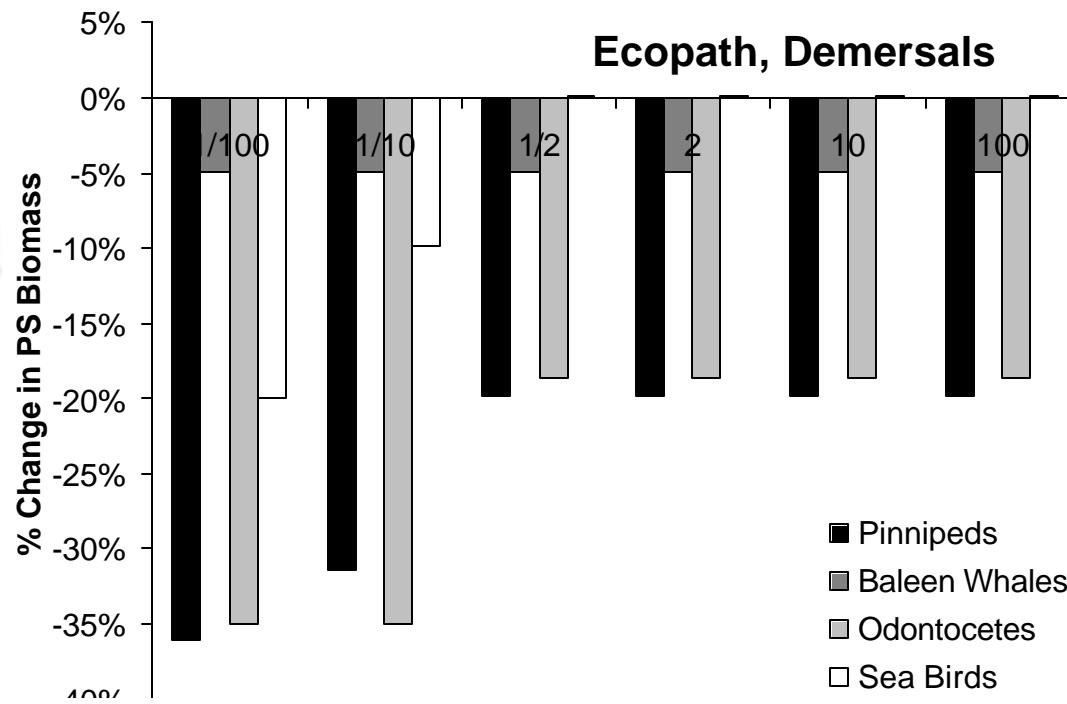
Ecopath, Small Pel



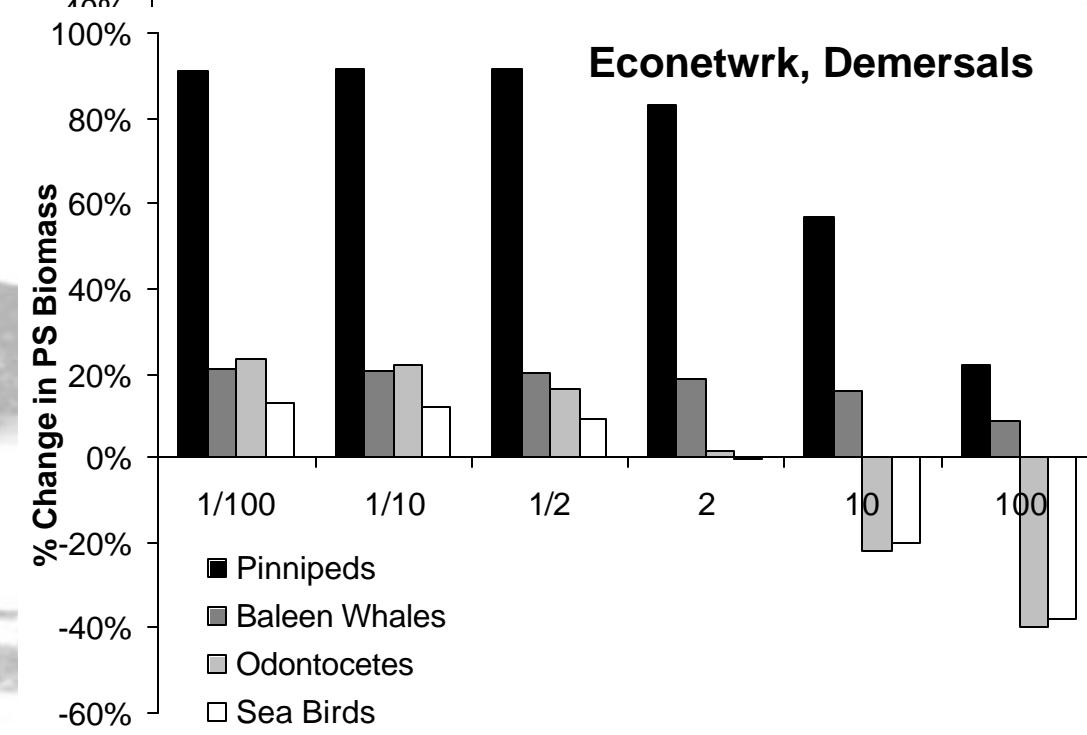
Econetwork, Small Pel



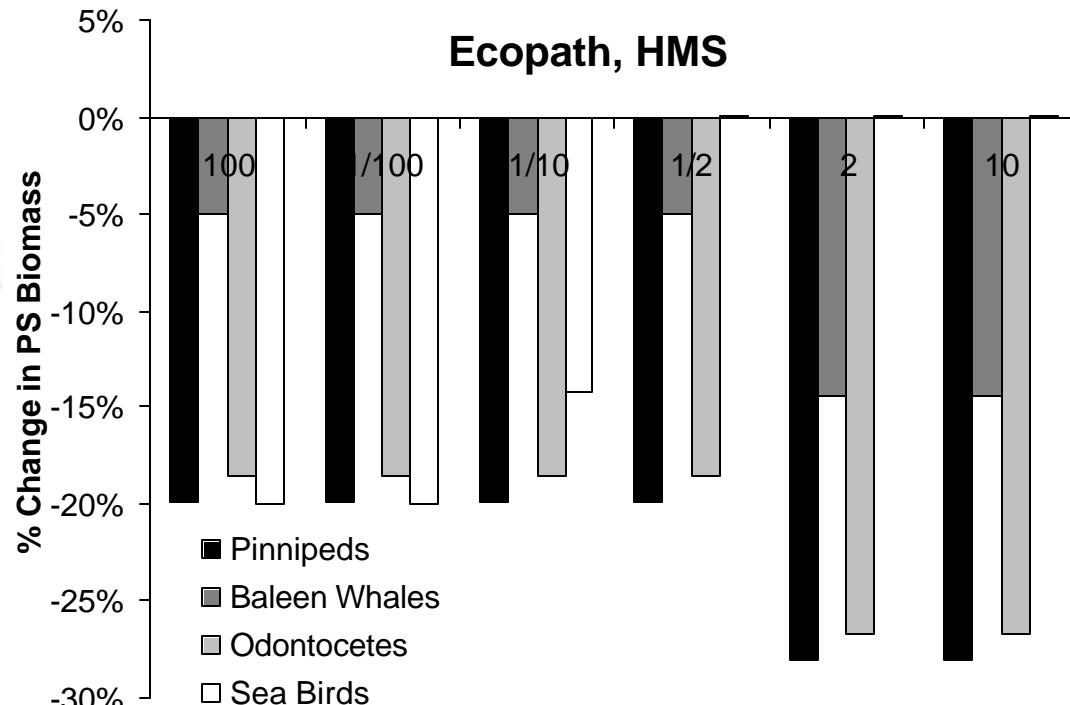
Ecopath, Demersals



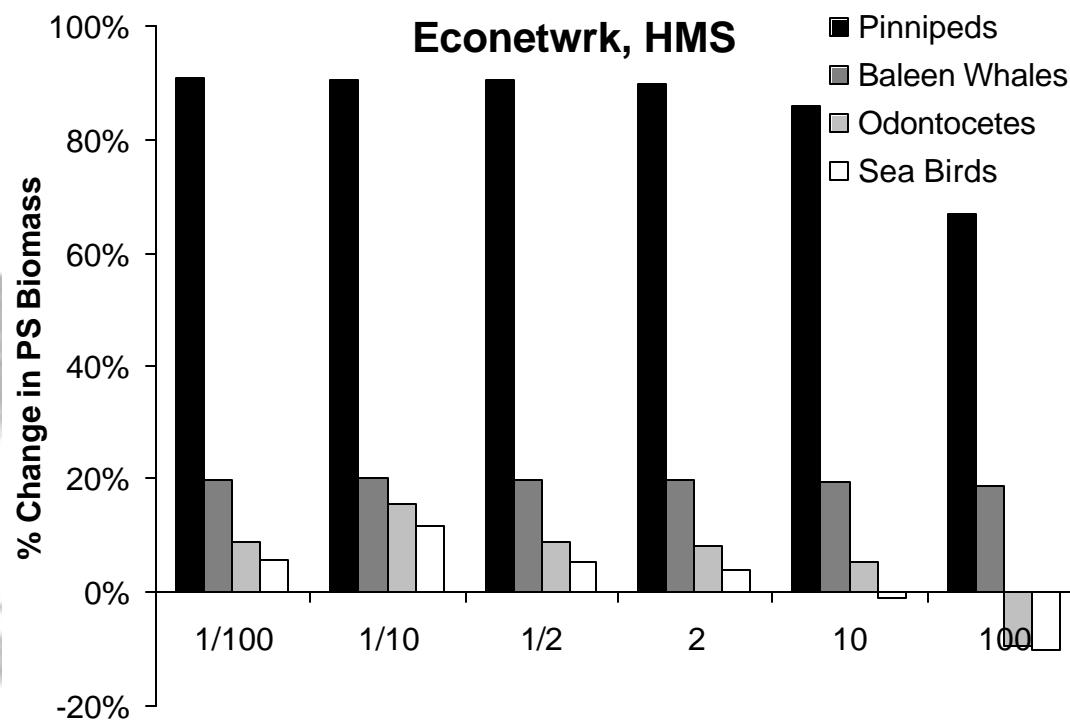
Econetwrk, Demersals

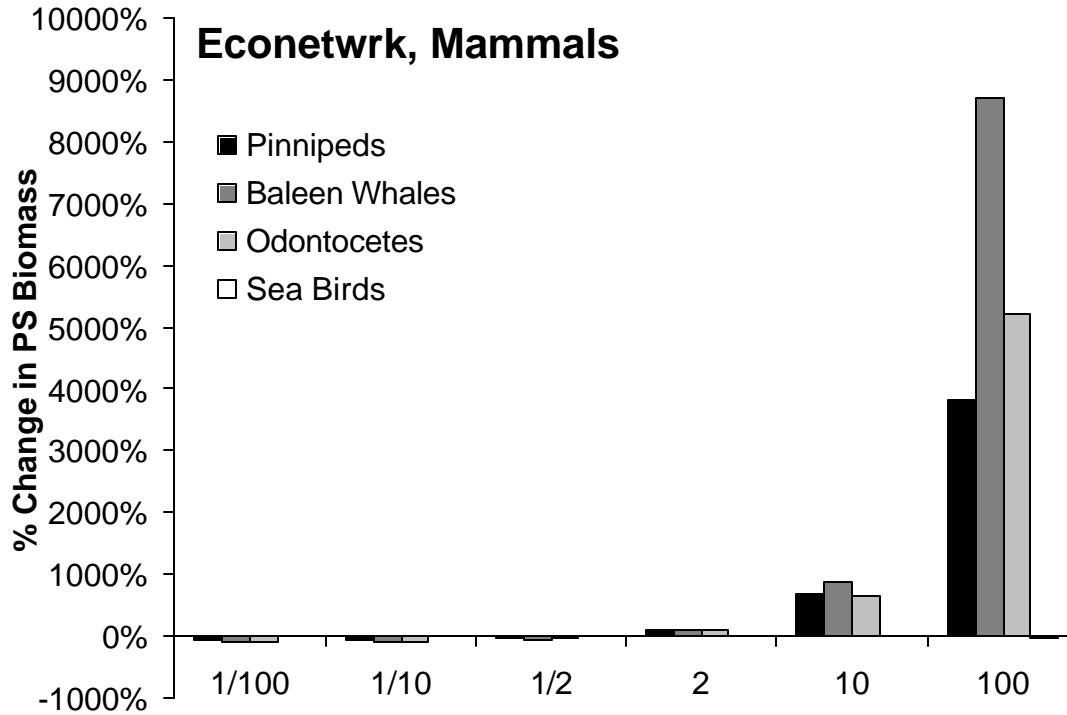
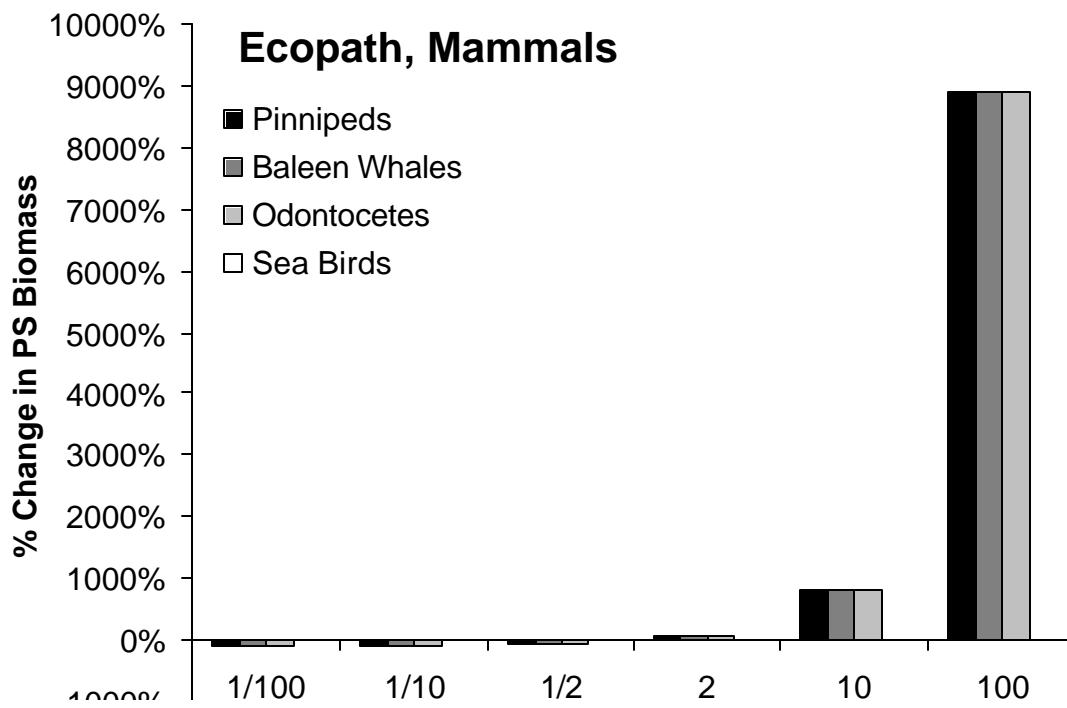


Ecopath, HMS



Econetwrk, HMS





EMAX Scenario Summary

- Overall changes to major fish groups resulted in compensating changes to other fishes
- - Systemic compensation
- Upper TL had minimal impact on rest of network
 - Mammals had a counter-intuitive effect on fish
- Categorically Gelatinous ZP and macrobenthos declined, most other ZP increased- hardwiring artifact?

EMAX Scenario Summary

- Effects by Marine Mammals relatively minimal; categorically positive on main prey (small pel, zp)
 - Results counterintuitive?
- Effects on Marine Mammals generally negative in Ecopath; variable in Econetwork
 - Both varied with prey & competitor abundance
 - Less competitors, more Marine Mammals
 - More small pelagics, more Marine Mammals

EMAX Data Gaps

Group	B	P/B	Q/B	Diet	Catch
Phytoplankton- Primary Producers	5	5	---	---	---
Bacteria	2	2	2	2	---
Microzooplankton	2	2	2	2	---
Small copepods	4	3	3	2	---
Large Copepods	4	3	3	2	---
Gelatinous Zooplankton	3	2	2	2	0
Micronekton	3	2	2	2	---
Mesopelagics	3	2	2	3	---
Macrobenthos- polychaetes	4	3	3	2	0
Macrobenthos- crustaceans	4	3	3	2	0
Macrobenthos- molluscs	4	3	3	2	0
Macrobenthos- other	4	3	3	2	0
Megabenthos- filterers	4	3	3	2	4
Megabenthos- other	3	3	3	2	4
Shrimp et al.	5	3	3	2	5
Larval-juv fish- all	3	2	2	3	0
Small Pelagics- commercial	5	7	7	5	5
Small Pelagics- other	4	5	5	4	3
Small Pelagics- squid	4	5	5	4	5
Small Pelagics- anadromous	4	5	5	4	4
Medium Pelagics- (piscivores & other)	4	5	5	5	5
Demersals- benthivores	5	5	7	5	5
Demersals- omnivores	5	5	7	5	5
Demersals- piscivores	5	5	7	5	5
Sharks- pelagics	3	4	4	4	3
Sharks- coastal	3	4	4	4	3
HMS	3	6	4	4	3
Pinnipeds	4	3	3	3	3
Baleen Whales	4	3	3	3	3
Odontocetes	4	3	3	3	---
Sea Birds	4	3	3	4	---
Fisheries- demersal	---	---	---	---	3
Fisheries- pelagic	---	---	---	---	3
Discards	---	---	---	---	3
Detritus- POC		2	1	1	1
DOC		2	1	1	1

EMAX Data Gaps

Major culprits:

Gelatinous ZP

Shrimp

Bacteria

Micronekton

Mesopelagic fishes

Macro & Mega benthos

Microzooplankton

Larval fish

Major rates (P, C, R)

Diet Compositions

Landings Spatially

EMAX

- Some Products and Application
 - A compiled, integrated catalogue of information and data
 - Identification of information gaps
 - Basis for further modeling, ecosystem assessments, & FEPs
 - Enhancements to SS TS, NTS and PS assessments
 - Holistic consideration (coordination) of SS assessments
 - Organizational Considerations

Future EMAX Efforts

- Evaluate additional cybernetic metrics
- Historical comparisons
- More detailed comparisons among 4 subregions
- Global comparisons
- More formal scenario testing